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Practical Thinking: Review of Cognitive Instruction Programs for Battle Command

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For additional detail, see ARI Technical Report 1037, *Practical Thinking: Innovation in Battle Command Instruction,* by J.J. Fallesen, R.R. Michel, J.W. Lussier, & J. Pounds.

14. ABSTRACT *(Maximum 200 words)*:

ARI developed a program of instruction on thinking, reasoning, and decision making at the request of the Training and Doctrine Command and the Command and General Staff School. Approaches to cognitive instruction are reviewed in the report. The findings support the adoption of a cognitive skills approach, but the benefits of the previous programs have not always been well established. The 15 programs that were reviewed identify various cognitive and metacognitive skills, attitudes, heuristics, and tools that were applicable to a curriculum for Practical Thinking. None of the previous programs were developed for application to specific job domains, and only two included adults in the targeted training audience. The review shows that previous programs have not been applied to specific career or job tracks, including Army leadership positions.

15. SUBJECT TERMS

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PRACTICAL THINKING: REVIEW OF COGNITIVE INSTRUCTION PROGRAMS FOR BATTLE COMMAND

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PRACTICAL THINKING: REVIEW OF COGNITIVE INSTRUCTION PROGRAMS FOR BATTLE COMMAND

Requirement

In August 1994 the Commander of the Training and Doctrine Command, GEN Frederick M. Franks, Jr., requested that ARI play a pivotal role in developing a course for mid-career Army officers. He asked that instruction on thinking, reasoning, and deciding be developed for inclusion in a course on the art of Battle Command. In the subsequent four months the concept, content, and integration of the instruction into the Command and General Staff Officers Course were completed by ARI researchers.

Goal

A search of previous cognitive instruction programs was instrumental in preparing for instructional development. The search and review of the programs was important to provide information on the empirical support for cognitive skill development approaches. More importantly the review of previous programs was useful to focus areas where cognitive skills are most needed to be improved and most amenable to improvement. The review was also seen as a source of lesson materials to be included in the course. This report documents the findings from the review of cognitive instruction programs with these uses in mind.

Background

The current interest in cognitive instruction in critical thinking has arisen from evidence of the current *lack* of thinking ability among students, according to Idol and Jones (1991). This has resulted in a movement where educators have been asked to promote critical thinking with cognitive instruction in the classroom. Cognitive instruction refers to any effort in teaching or designing instructional materials to help students process information in meaningful ways and to become independent learners, encompassing problem solving, decision making, critical and creative thinking, memory, expert teaching, and metacognition (Idol & Jones, 1991). One overall goal in cognitive instruction is to help students learn how to learn. This refers "not only to independent application of specific strategies but also to self-appraisal and self-regulation of the process of learning" (p 70). The definition and goal of cognitive instruction contrasts with traditional instruction which focuses on content, and may or may not consider transfer and application of specific skills.

There has been an ongoing debate in the educational literature on whether to teach thinking skills in a separate or an integrated curriculum, and whether or not thinking skills taught separately will transfer or generalize to relevant contexts (Idol & Jones, 1991, p. 443). In their book, *The Teaching of Thinking*, Nickerson, Perkins, and Smith (1985) respond to the debate by stating that "many students do not acquire the ability to think very effectively as a consequence of their educational experience, and, until recently, relatively little attention has been given to the possibility of making the teaching of thinking skills a primary educational objective, in the sense in which the teaching of reading, writing and mathematics are primary educational objectives" (p 6). Voss, Perkins, and Segal (1991) state that although schools do not teach cognitive instruction as a separate subject, students are assumed to receive instruction in reasoning as a byproduct of instruction in other subjects; yet when examined further, these

courses do not necessarily make challenging cognitive demands on students. Since Army officer's leadership development programs have not emphasized to any degree cognitive competence (Kluever, Lynch, Matthies, Owens, & Spears, 1992), practical thinking skills are explored in this program.

The ability to think clearly is a special concern in Battle Command. While tactical commanders and staff officers have the ability to think clearly, they may not apply that ability to the fullest extent possible due to the stress, immediacy, and complexity of the dynamic problem situations that face them. It is assumed that explicit instruction can promote better thinking under these conditions. The cognitive skill requirements of Battle Command can be made more explicit by focusing on them and incorporating them into instruction. The purpose of the review was to determine what has been learned from past programs that would apply to the development of cognitive instruction for mid-career Army officers.

Cognitive Instruction Programs

The following summary describes fifteen cognitive instruction programs. Candidate programs were identified from literature searches. For programs to be selected they had to have substantial thought and effort behind them. Review emphasis was placed on program evaluation, usefulness, adaptability, and predictive outcome. The programs were analyzed by considering nine different questions:

1. What are the underlying assumptions of the program?
2. What are the overall goals of the program?
3. What types of methods and materials are used in the program?
4. What are the specific thinking skills taught in the program?
5. What is the program's target population?
6. What is the expected outcome of the program?
7. Do the activities promote independent generalized learning?
8. What types of activities are learners engaged in?
9. What evidence of skill acquisition is available?

Of these questions, promotion of independent generalized learning (#7) is probably the most important. If students are unable to apply the concepts taught and in appropriate new learning situations, then the effort devoted to direct instruction is wasted. This is also one of the most difficult to assess because it is difficult just to measure thinking performance within the benign conditions of the classroom, let alone the more complex situations of the world and learning over time.

Descriptions of the programs are ordered chronologically. They include instructional topics dealing with attitudes, cognitive skill, tools, and metacognition. Tables 1 through 3 summarize the concept and targeted skills of each of the programs.

Table 1.
Description of cognitive instruction programs (1967-1976).

Program	Concept	Amount	Audience	Attitudes	Skills
Structure of intellect 1967	Students learn basic skills, domain knowledge and critical thinking; what kinds of intelligence, not how much.	instruction based on taking SOI diagnostic tests	preschool to adult	Improve self-concept and attitudes toward school.	cognition, memory, evaluation, convergent & divergent production
Cognitive Research Trust Thinking 1973	Improve perceptual thinking through the use of tools that draw attention to perception. Practice with tools for short time (2-4 mins) to avoid focus on content.	1 lesson (2-4 min)/ week/ 2 yrs	ages 9 to 12	Accept that perceptions can be wrong, choose reflective over impulsive response, separate issues of ego from thinking, counter tendencies to be egocentric.	broaden thinking, organize thinking, assess evidence, escape from imprisoning ideas, restructure problem space, tools: PMI, CAF, C&S, EBS, ADI, OPV, HV, LV, AGO, TEC (see pages 7-8)
Productive Thinking Program 1974	Improve thinking through general strategies or guides.	15 booklets in comic book format	5th-6th graders	Use more original ideas, persist at problem solving, have curiosity, use thinking guides for problems, have confidence in own ideas	discovering & formulating problems, organizing & using information, generating ideas, evaluating & improving ideas, creating new perspectives
Patterns of problem solving 1975	Need to experience a variety of problem situations to form metaknowledge about which heuristics to apply and when.	2 college courses	college students	Follow hunches, attend to feelings, provide foundation for attitudes in dealing with problems in the context of human values.	overcome conceptual blocks and self-imposed constraints, represent problem, restate question, challenge premises, use analogies, use partial solutions, use concrete representation and consider many alternate COAs
Philosophy for Children 1976	Reason well.	40 mins 3 times a week	grades 3 to 12	Think for themselves and enjoy thinking.	inquiry, discovery, invention, inference, inductive reasoning, generalization, contradiction, possibilities, cause & effect, explanations & descriptions, consequences, alternatives to own point of view, evidence objectively, presuppositions, reasons for beliefs

Table 2.
Description of cognitive instruction programs (1979-1984).

Program	Concept	Amount	Audience	Attitudes	Skills
Heuristic instruction in mathematical problem solving 1979	Teach managerial approach to use of heuristics for math.	5 phase training	college students		Identify givens and unknowns, develop a plan for proceeding, explore what to do when path is not clear, carry out plan, check solution, use managerial strategies
Practicum in Thinking 1979	Encourage students to reflect on how they think.	2 hrs twice a week for 10 weeks	college students	Self-awareness, learn something about self.	approach problems in more than one way, recognize choices in how problem approached, approach problems systematically
Instrumental enrichment 1980	Correct cognitive deficiencies caused by attitudes, learn how to learn.	minimum of 80 hours over 1 to 3 years	age 11 to adult	Reflectivity vs. impulsivity, appreciate accuracy, active generator of knowledge, intrinsic motivation.	categorization, recognizing relationships, planning, elaboration, interpretation, learning, organizing, logical reasoning, metacognitive awareness, generalize, synthesizing
Heuristic Model 1984	Teach prediction along with thinking skills. Skills are taught individually and combined to produce inventions.	Embedded within curriculum	gifted elementary and secondary students	Increase curiosity, questioning attitude is rewarded, make learning enjoyable, reduce boredom with challenges.	recall, recognition, comparison, cause-effect relationships, class inclusion and exclusion
IDEAL 1984	Aid people to identify and understand components of problem solving so they can become independent learners.	Instruction to be centered around actual problems	school children and adults	View problems as opportunities, self-confidence, decrease fear of new domains and criticism, increase risk taking.	identify problems, define goals, explore possibilities, anticipate possible outcomes, act, learn from experience

Table 3.
Description of cognitive instruction programs (1985-1992).

Program	Concept	Amount	Audience	Attitudes	Skills
Critical Thinking in American History (CTAH) 1985	Informal thinking, good reasons for beliefs, thinking skills should be taught explicitly.	4 book supplements to high school Am History	high school	Self-reflective, willingness to suspend judgment, view knowledge as fragmentary and open to interpretation, seek knowledge rather than facts.	provide good reasons for beliefs, evaluate evidence, recognize assumptions, go beyond simple solutions, distinguish conclusions from premises, identify imprecise words, connects in an argument
Intelligence Applied 1986	Improve metacognition using 'triarchic' theory of intelligence. Enable students to identify and avoid obstacles to intellectual development..	semester or year-long course	high school & college students	Find ways for self-motivation. View oneself as one's own coach.	identify potential problems during planning stages, understand how different definitions lead to different strategies, select strategies, monitor effects, infer meanings of new words from context, conflict resolution
Odyssey 1986	Improve reasoning, with some attention on creativity. Intellectual performance is best improved through dialogue and discovery learning.	45 min/3-4 times a week/2 yrs (99 lessons)	grades 4 to 6		understanding language, precise use of language, verbal reasoning, problem solving, decision making, careful observation, deductive reasoning, inferential use of information, hypothesis generation & testing, inventiveness
Conceptual Infusion 1987	Teach how to learn, covering thinking skills and strategies in natural contexts.	textbooks with thought-provoking situations	elementary & high school	Reflective thinking directed at deciding what to believe and do and why something happened.	conceptualize alternative possibilities, look for good evidence, rule out competing hypotheses, collect & assess evidence, judge reliability & accuracy of information, exercise clarity & precision in thinking
Jasper Series 1992	Motivate students to think about important, complex problems. Active construction of knowledge.	15-20 min videotaped adventures of a central character are used	late elementary to early high school	Motivate to think and reason. Foster self-directed learning	consider multiple factors explore, assess, revise own ideas solve interconnected problems

Structure of the Intellect (SOI) (Guilford, 1967; Guilford & Hoepfner, 1971); extended by Meeker (1969) into a design for educational application.

Assumptions: Based on Guilford's model of intelligence, SOI is a diagnostic and prescriptive measure of intelligence described in terms of the intersection of five mental operations, four contents, and six products. It is assumed that all students have intelligence and the SOI program answers "What kind?" rather than "How much?"

Goals: To lay the basic foundation for sequencing learning abilities. Once basic abilities are mastered, higher-level reasoning or critical thinking abilities are more easily assimilated. The overall goal is to equip students with the necessary intellectual skills to learn subject matter and critical thinking.

Methods and materials: The method is straightforward. First, students take a battery of diagnostic SOI tests, usually the SOI-LA (learning abilities) tests. The battery consists of items within each of the following categories: cognition, memory, evaluation (judging, planning, decision making, analysis, reasoning and logic), convergent production (problem solving), and divergent production (creative problem solving). Finally, after the results are available, suggestions are made on how to improve weaknesses.

Thinking skills: Guilford's three dimensional model of the SOI is classified into three general categories with specific sub-areas: (1) Operations - cognition, memory, convergent and divergent thinking. (2) Content - figural, semantic, symbolic, behavioral. (3) Products - units, classes, relations, systems, transformations, implications.

Targeted population: preschool to adult.

Expected outcome(s): After diagnostic tests indicate areas of intelligence that are weak, "prescriptions" are made which are expected to positively affect the weaknesses.

Promotion of independent generalized learning: There are no readily available reports of direct measures of the impact of the training or general school performance.

Example: If a pupil is found to be weak in divergent production, the following may be prescribed: Teachers and parents should work with the student to reclassify objects, pictures, numbers and words used in unusual ways, and brainstorm ideas and write creatively.

Efficacy evidence: There is fair amount of research regarding the effectiveness of the SOI. Broadly, evidence indicates that intelligence can be trained and result in an improved self-concept and improved attitudes towards school. Specifically, one study indicated that the SOI test was effective in assisting educators in diagnosing and aiding students toward greater school achievement. Another study reported that there were significant gains in SAT assessments of arithmetic but not reading ability. One source indicated that "the SOI program improves intelligence" (Nickerson, Perkins, & Smith, 1985, p 168).

Cognitive Research Trust Thinking (CoRT) (de Bono, 1973, 1976, 1991)

Assumptions: There are two stages in thinking: perception and analysis. Poor thinking is often due to errors in perception, rather than analysis. Perceptual skills are neglected by schools and therefore deserve greater attention in thinking programs.

Goals: Although analytic thinking is covered, the emphasis is on improving perceptual thinking through the use of "tools," such as PMI (Plus, Minus, Interesting) and C&S (Consequences and Sequels), which draw attention to the perceptual stage of thinking.

Methods and materials: Practice in use of perceptual tools on real-life problems through group and class discussion. One fast paced lesson per week for two years.

Thinking skills: Breadth - how to broaden thinking; organization - how to organize thinking; interaction - how to assess evidence; creativity - how to escape from imprisoning ideas; and action - concerned with the total process of thinking.

Tools are the thinking skills that students practice in CoRT lessons. The CoRT tools have deliberately strange-sounding names in order to make them separate from content as attention-directors. The tools are practiced on a wide range of situations described on student work cards. Each situation is only considered for a short burst of time (2-4 minutes). Then the student applies the tool to another matter. This process is purported to be most effective in keeping attention on the tool rather than on the content. Once the tool is mastered, the skill can theoretically be applied to mastery of content in various subjects.

PMI: P stands for Plus (the good points), M stands for Minus (the bad points), I stands for the Interesting points about a problem. The interesting points raise *what if* questions. PMI encourages students to look at different aspects of the situation instead of making an initial judgment. The explanation following the PMI description includes techniques for generating alternatives, being perceptive, identifying patterns, and using humor.

CAF (Consider All Factors) - CAF involves an explicit listing of advantages and disadvantages. Designed to counter the supposed natural tendency of humans to be egocentric.

C&S (Consequence and Sequel) - Designed to assist the student in explicitly thinking of long term possibilities, as opposed to the usual impulsive response.

EBS (Examine Both Sides) - Students are encouraged to take the opposing side in an argument and develop it, even beyond the actual view of the other person.

ADI (Agreement, Disagreement and Irrelevance) - ADI directs attention to areas of agreement, disagreement, and irrelevance. Judgment about what makes up these areas depends on the student.

OPV (Other People's Views) - The student is encouraged to consider the points of view of all those involved and express them.

HV/LV (High values/low values) - Values are divided into high and low to encourage a closer examination of the values involved in a situation.

AGO (Aims, Goals, and Objectives) - Students are shown to resist the temptation to discriminate between aims, goals, and objectives unless a particular situation lends itself to the use of a particular term.

TEC (Target and Task, Expand and Explore, Contract and Conclude) - This tool is meant to encourage more deliberate thinking.

Targeted population: ages 9 to 12.

Expected outcome(s): To teach lateral thinking skills (i.e., learning to restructure the problem space) as opposed to vertical or logical thinking (i.e., sequential, predictable, and unconventional).

Promotion of independent generalized learning: Once students master the tools, they are encouraged to use them in all subjects. Transfer to other domains and subject matter is expected to occur spontaneously.

Example: The students are asked by the teacher whether they would like to be paid five dollars a week for attending school. Working in small groups, the students list all of the good points about the idea, then the disadvantages, and finally the features that are not easily classified as either plus or minus, but are worthy of notice.

Efficacy evidence: Much of the research regarding the effectiveness of CoRT is reported in anecdotal form, but little is available regarding statistical analysis of improved performance on specific tests of reasoning or correlated with increased standardized achievement tests. A study by de Bono (1976) revealed that CoRT trained students tended to give more attention to all sides of an issue, considering general as well as personal consequences. The issue of transfer of CoRT skills into other subjects, according to de Bono, depends largely upon whether the teacher reminds students to do so.

Productive Thinking Program (Covington, Crutchfield, Davies, & Olton, 1974)

Assumptions: Productive thinking involves five kinds of thinking skills. Improvement in these skills may be accomplished through instruction in general strategies ("thinking guides"). Direct instruction and practice are essential. Development of good attitudes is fundamental to success.

Goals: To teach the use of sixteen thinking-guides that are helpful in productive thinking.

Methods and materials: Students read fifteen booklets in comic book format, and practice thinking by answering questions and confronting story characters. Booklet exercises are discussed by the class. The program is usually taught in one semester.

Thinking skills: Thinking productively requires the use of reasoning and critical analysis

but also imagination and creativity. It involves five kinds of skill: discovering and formulating problems, organizing and using information, generating ideas, evaluating and improving ideas, and creating new perspectives.

Targeted population: primarily fifth- and sixth-grade students; suitable for all students except the slowest learners.

Expected outcome(s): Students are expected to use more original ideas, persist at problem solving, have curiosity, and use thinking-guides in attacking problems.

Promotion of independent generalized learning: Some exercises show students how the thinking-guides apply to their regular schoolwork. For example, in one exercise students are asked to identify the guides that might be used in writing an essay.

Example: In the first lesson, the two principle characters enter a map-making contest. One character is unable to come up with any ideas at all, and the other character has ideas but lacks the confidence to share them. The characters' reactions should be familiar to the children and serve to show them that many others share their fears and frustrations when faced with problems.

Efficacy evidence: Research on the effectiveness on this program has yielded mixed findings. Sometimes the program produced significant gains on a range of posttests, and sometimes it did not. One study noted that the greatest successes seem to have been achieved under the least well controlled conditions; they suggest that the program might be most effective when applied in a small group with an enthusiastic teacher.

When testing for transfer to similar problems, performance was measured in several ways: ultimate success or failure, fluency in generating options, quality of ideas, and anomalies noticed in the data that may point to a solution. The findings of three experiments significantly favored the treatment group over the control. However, on individual items, sometimes one measure of performance had an advantage over another (e.g., more fluency, better quality ideas, noticing anomalies, but without solving the problem more frequently).

Regarding divergent thinking, the various ideational fluency instruments used in the evaluations did not show gains in the treatment groups relative to the control group. For problems and tasks of a markedly different character, there is no clear evidence that the program helps. However, it has not been tested how well the program might prepare students to deal with complex problems on their own.

Patterns of Problem-Solving (Rubenstein, 1975, 1980)

Assumptions: What one needs in order to be an effective thinker is a variety of problem situations, along with metaknowledge about situations in which specific heuristics are appropriate.

Goals:

1. To develop a general foundation of problem solving approaches and master some techniques.

2. To provide a foundation for attitudes and skills productive in dealing with problems in the context of human values.
3. To emphasize the thinking process at all stages of the problem solving activity.
4. To identify individual problem solving styles and learn to overcome conceptual blocks and self-imposed constraints.
5. To expose students to both objective and subjective aspects of problem solving.
6. To provide a framework for a better appreciation of the role of tools and concepts acquired.
7. To bring together students from diverse backgrounds so that they can observe different attitudes and problem solving styles and learn from each other. (Rubenstein, 1980, p 26)

Methods and materials: The text, *Patterns of Problem Solving* (Rubenstein, 1975), is designed to provide the reader with tools and concepts that are productive in problem solving, and are least likely to erode over time. The two courses at UCLA have come from the first and second portions of the text.

Thinking skills: Metacognition, problem representation, course of action selection and implementation, representation transformation, restatement of the question, challenging of premises and assumptions, using analogies and metaphors, discussing the problem with others, using partial solutions, following hunches and attending to feelings.

Targeted population: college students.

Expected outcome(s): To improve everyday problem solving by using concrete representation and systematically considering many alternative courses of action.

Example: Use of diagrams for representing problems, math word problems, probability problems, etc.

Efficacy evidence: A general intelligence (IQ) test (California test of Mental Maturity, Short Form 1963) was given to students before and after taking the college course in Patterns of Problem Solving. Rubenstein (1980) reports an average improvement of 5.4 scale points in IQ.

Philosophy for Children (Lipman, 1976)

Assumptions: Thinking well requires the ability to perform numerous reasoning skills, most of which are best learned through the use of language (i.e., dialogue).

Goals: To teach students to reason well and to enjoy thinking for themselves.

Methods and materials: Students meet three times a week for forty minutes to read, do exercises, and talk. The focus of the class is a novel in which the characters discover and model principles of reasoning in the process of exploring philosophical issues. Teachers use a variety of special techniques to model and elicit reasoning skills.

Thinking skills: Inquiry, discovery and invention, inference, inductive reasoning, styles of thinking, generalization, contradiction, possibilities, cause and effect, explanations and

descriptions, and considering consequences when deciding what to do.

Targeted population: grades 3 to 12.

Expected outcome(s): To help students think for themselves, to explore alternatives to their own point of view, to consider evidence more logically and objectively, and to search for presuppositions and reasons for their beliefs.

Promotion of independent generalized learning: Practical applications of the principles of logic that are being studied are emphasized, and practice is provided in analyzing logically such things as advertisements, letters to the editor, and political cartoons.

Example: An important philosophical exercise is that of uncovering the presuppositions on which questions and statements are based. Teachers can help students search for assumptions by asking them, "Are you assuming that...? or Doesn't what you say depend upon the assumption that...?"

Efficacy evidence: In a Rutgers University study, a comparison of reading skills on the Metropolitan Achievement test revealed that students who had gone through the program gained an average of eight months in reading ability, while a control group gained five months. The program took 80 classroom hours to achieve the 3 month gain in reading ability.

Heuristic Instruction in Mathematical Problem Solving (Schoenfeld, 1980)

Assumptions: Heuristics help students solve problems when the students know and apply the heuristics, but students lack a good set of heuristics. Students do not reliably pick up heuristics spontaneously from examples; heuristics have to be explicitly taught. Students do not reliably apply heuristics they know about; some sort of guidance or prompting is necessary. A "managerial strategy" for approaching problems, taken together with heuristics, can help students to apply heuristics and lead to substantially improved problem solving performance in mathematics.

Goals: To not only teach the use of heuristics in solving math problems, but to teach them in a "managerial" manner. In other words, once a problem is attacked, the problem solver will continue to monitor his progress by applying heuristics throughout the process.

Methods and materials: Training occurs in the following five phases:
1. Analysis - once a problem is given, the aim is to get a "feel" for the givens and unknowns. Another aim is to simplify the problem using heuristics.
2. Design - to develop a plan for proceeding and ensure that detailed calculations are not done prematurely; no specific heuristics are suggested.
3. Exploration - Chosen when the problem presents difficulties and no clear plan for directly producing a solution is at hand; several heuristics are suggested.
4. Implementation - used when a plan is in hand that should lead to a solution if carried through; no heuristics are suggested.
5. Verification - to check the solution; several heuristics are suggested.

Thinking skills: The trained use of heuristics in a "managerial" manner.

Targeted population: college students.

Expected outcome(s): To significantly impact in a positive manner the math problem solving skills of the math student.

Promotion of independent generalized learning: There was no information addressing this in the literature reviewed.

Example: During the analysis phase, the problem solver may try to diagram the problem, in order to simplify it.

Efficacy evidence: Experimental evidence suggests that the instruction results in substantial improvements in math problem solving.

A Practicum In Thinking (Steiner, 1979)

Assumptions: Steiner's motivation for developing a course followed from the conviction that "in general, our education system does not teach its students how to think, nor does it seek directly to do so" (Steiner, 1979, p.3).

Goals: This approach has a distinctly metacognitive aspect. Emphasis is placed on self-awareness. Students are encouraged to introspect on how they are performing the tasks. The purposes of the project are (1) to get the student to learn something about themselves by paying attention to how they go about solving the problem, (2) to make them aware of the element of choice in strategizing for problem solving, and (3) to teach them the value of approaching a problem systematically.

Methods and materials: The class, the size of which is limited to about 25 students, meets for 2 two-hour sessions per week for 10 weeks. It is divided into four groups of roughly equal size that stay together throughout the 10-week period. Class sessions are usually devoted to exercises, each of which addresses a specific goal. Each exercise ends with a set of questions for discussion to help the students analyze what they have learned in doing it.

Thinking skills: Topics include the following: working in groups, listening, words and meanings, assumptions, study skills, memory, problem analysis, logical inference, problem solving, decision making, and creative problem solving.

Targeted population: college students

Expected outcome(s): To make students realize that most problems can be approached in more than one way, and to make them conscious of the fact that they have some options in that regard.

Promotion of independent generalized learning: There was no information addressing this in the literature reviewed.

Example: Students are required to work on a problem of their own choosing as a special course project, for example deciding about graduate school.

Efficacy evidence: Attempts to evaluate the effectiveness of the course have included self-evaluations by the students before and after the course, with respect to certain specific skills (working with others, memory, and generating new ideas). Students considered themselves to be more adept after the course than before the course. Even if there were no actual gains in skill, this enhanced self-perception could have a positive effect on the students' handling of problems (Wheeler & Dember, 1979).

Instrumental Enrichment Program (Feuerstein, 1980; Savell, Twohig, & Rachford, 1986)

Assumptions: Students learn to think by means of "mediated learning experiences." A mediated learning experience is when someone other than the learner or something else (e.g., computer assisted instruction) directs attention to salient teaching points. A lack of such experiences may result in "cognitive deficiencies."

Goals: To correct cognitive deficiencies such as impulsivity and lack of appreciation for accuracy; to replace a passive orientation with an active one. The six subgoals of the program include: (1) correction of deficient cognitive functions, (2) acquisition of certain basic concepts, labels, vocabulary, operations, and relationships necessary for cognitive tasks, (3) production of intrinsic motivation, (4) production of reflective, insightful thinking, (5) creation of task-intrinsic motivation, and (6) instillation in the self as an active generator of knowledge and information.

Methods and Materials: Fifteen units consisting of paper and pencil exercises designed to correct cognitive deficiencies. One-hour classes meet three to five times a week for two to three years. Teacher leads discussion of exercises. Eighty hours or more are required over a 1 to 3 year period.

Thinking skills: The skills include categorization, orientation in space, recognizing relationships, following directions, planning, organizing, logical reasoning, and synthesizing.

Targeted population: ages 11 to adult.

Expected outcome(s): To correct cognitive deficiencies such as impulsivity and inaccuracy in student responses to learning.

Promotion of independent generalized learning: Students are required to work independently with emphasis placed on teacher mediation of feelings of competency and on developing and maintaining motivation; skills are taught within isolated contexts; then bridging activities are presented that are intended to expedite transfer.

Example: One lesson involves comparisons, in which the student is required to look for similarities and differences between two or more objects or concepts. The dimensions examined are sometimes concrete (number, color, form) and sometimes abstract (function, composition, power). In another exercise, the student ranks five figures according to how closely they resemble a model.

Efficacy evidence: Twohig, Rachford, Savell, and Rigby (1987) state that where the program has been implemented thoroughly and reliable measures have been used, there has been an improvement in cognitive performance. Typically, there is no evidence for statistically significant results until well into the program (close to 100 hours of training). Feuerstein (1980) found that students who had gone through the program continued to improve in cognitive performance, relative to control groups two years after the program ended.

Heuristic Model (Friedman, 1984)

Assumptions: Content mastery is becoming less important because today's information quickly becomes obsolete but the skills necessary for processing information are becoming more important. Heuristics help one learn by providing a method for learning and investigation that can be applied to a wide range of content or situations. Thinking skills taught directly is superior to incidental learning.

Goals: Teach prediction concurrently with supporting thinking skills in a combined process.

Methods and Materials: Teachers choose a strategy based on assessing student knowledge or ability for a specific area, such as the American Civil War. The teacher may choose homework or classroom instruction to remedy the deficiency. The teacher plans how to teach each basic skill in the context of the Civil War.

Thinking skills: identification (concrete, categorical, programmatic, hierarchical), identifying problems, predicting events, predicting consequences, testing predictions, and revising predictions.

Targeted population: gifted learners; below the 5th grade the order of presentation is modified.

Expected outcome: Students will combine thinking skills to solve problems.

Promotion of independent generalized learning: The program claims that teaching of higher order thinking skills will lead to improved ability to discover and invent.

Example: For the skill of predicting the consequences of solutions, the teacher might have the students identify how the Union thought the Confederacy could be defeated. The teacher explores in more depth what planning and actions had to take place.

Efficacy evidence: None given in sources reviewed.

IDEAL (Bransford & Stein, 1984, 1993)

Assumptions: People are capable of figuring out a workable solution if they think about the problem. People can learn to deal with the problems that they encounter by paying attention to their approach to problem solving. This will be especially important when people are faced with nonroutine problems. A requirement for successful problem

solving is effective learning.

Goals: To show people which problem solving processes that work and which do not. The IDEAL model is to help improve problem solving. IDEAL stands for Identify problems and opportunities, Define goals, Explore possible strategies, Anticipate outcomes and Act, and Look back and Learn. The "ideal problem solver is someone who continually attempts to improve by paying attention to his or her processes and by learning from any mistakes that are made." (p xiii, Bransford & Stein, 1993).

Methods and materials: Students require frequent opportunities for self-assessment to analyze the effects of their actions and to learn from them. Instruction should be based on realistic problems that are relevant to the needs, interests, and skills of the students. The Problem Navigation Guide can be used to steer one through the IDEAL cycle.

Thinking skills: Students will be able to: recognize potential problems and treat them as opportunities, carefully define the goal, explore potential alternative approaches for solving the problem, anticipate likely outcomes before acting, and examine the outcome and its effects to learn from the experience.

Targeted population: The target population is not clearly specified, but it includes at least adults.

Expected outcomes(s): Existing knowledge will be used more effectively to solve problems and new information will be learned.

Promotion of independent generalized learning: The improvement of problem solving and learning skills should be ongoing activities.

Example: The problem of a squeaking door can be solved relative to the particular goal that is adopted. The solution to the problem depends on whether the goal is to (1) eliminate the noise, (2) keep the sound from entering another room because it disturbs the people in the room, or (3) to keep the sound from being disturbing. The goal that is selected suggests particular strategies for solution.

Efficacy evidence: None given in sources reviewed.

Critical Thinking in American History (CTAH) (O'Reilly, 1983-1985)

Assumptions: Thinking skills are like athletic skills and should be taught in a similar way. For example, a golf pro giving a lesson to a beginner breaks the swing down into its component parts and explains each component while supervising the learner, who practices for the next lesson. Thinking skills are unlike athletic skills, however, in that too much instruction on which skills to use may unnecessarily limit student creativity and insights.

Goals: The goal of CTAH is informal reasoning, or providing good reasons for beliefs. This encompasses skills such as evaluating evidence, recognizing assumptions, willingness to suspend judgment, and going beyond simple solutions.

Methods and materials: The CTAH project uses four books, along with associated teachers' guides. These materials are designed as supplementary resources for high school American History courses. The books are made up of historical problems and interpretations as well as skills worksheets that identify a broad range of informal reasoning skills.

Thinking skills: Identifying and evaluating evidence, distinguishing conclusions from premises, identifying unstated assumptions, identifying imprecise words, identifying connections among parts of an argument, and evaluating ethical claims.

Targeted population: high school.

Expected outcome(s): For students to change their view of the nature of knowledge, to begin to see it as fragmentary, selective, and open to interpretation, and to see knowledge as something to be sought after rather than something served as so many facts to be memorized.

Promotion of independent generalized learning: After students become skilled at analyzing other's arguments, they participate in classroom debates and prepare essays presenting their views of controversial issues. Students learn how to construct and evaluate their own arguments.

Example: Students are given the following argument and asked to find the ethical claim: "The U. S. was justified in taking a strong stand against the Soviets in the late 1940's, because the Soviets had broken their promise to hold free elections in Eastern Europe."

Efficacy evidence: O'Reilly (1983) states, "...some students have demonstrated a willingness to be more self-reflective. Journal entries on a decision-making simulation on the Vietnam war showed a great deal of empathy for historical decision makers...Dealing with assumptions, overgeneralizations, frames of reference, and so forth seems to have raised students consciousness and given them time to examine their own thinking." (O'Reilly, 1983, p 378).

Intelligence Applied (Sternberg, 1986)

Assumptions: This program is based on the "triarchic" theory of intelligence which consists of three parts:

1. mental processes that comprise intelligent behavior (metacomponents, performance components, and knowledge acquisition components).
2. real world contexts in which intellectual processes operate (skills for adapting to, shaping, and selecting environments).
3. experience and intelligence (the role of novelty and automaticity in intelligent performance).

The theory proposes that intelligence involves adapting to, shaping of, and selecting environments. Practical intelligence deals with problems that have no right or wrong answer. Intelligence differs depending on the effectiveness of response in situations involving elements of risk, uncertainty, and ambiguity.

Goals: The program is designed to help students improve their abilities to perform the processes assumed to underlay intelligent behavior.

Methods and materials: This can be used as either a semester or a year-long course. It consists of two elements: (1) a student's text with narrative material and exercises for students to complete, and (2) a teacher's guide with material used to maximize the program's effectiveness.

Thinking skills: The information-processing components of intelligence contain the following:
1. Metacomponents - defining problems, selecting strategy, solution monitoring.
2. Performance components - inferring relations between stimuli, mapping higher order relations between stimuli.
3. Knowledge acquisition components - selective encoding, selective comparison

Targeted population: secondary school and college students.

Expected outcome(s): Training is aimed at increasing students' abilities to identify potential problems during the planning stages of problem solving, to understand how different reasonable definitions of problems lead to different strategies, to select appropriate strategies, and to monitor the effects.

Promotion of independent generalized learning: Skills and procedures that have a great deal of generality are emphasized. For example, in the section on knowledge acquisition, students are taught to infer the meanings of new words from context, a skill most people can use throughout their lives.

Example: For instruction on practical intelligence, students are presented with scenarios of real-world problems for which they must generate conflict resolutions.

Efficacy evidence: Sternberg (1986) notes that the clinical data are highly favorable, however statistical outcome data are not presented.

Odyssey (Harvard University, 1986) (Note that Project Intelligence was a related program.)

Assumptions: Intellectual performance depends on abilities, methods, knowledge,and attitudes. These are best improved through dialogue and discovery learning.

Goals: To teach skills ("target abilities") needed for a wide variety of intellectual tasks. Includes creative-thinking skills, but emphasis is on reasoning.

Methods and materials: Ninety-nine forty-five minute lessons organized into six major themes. Students have three or four lessons per week over a period of two years. Lessons include dialogue and written exercises.

Thinking skills: The authors assume that intellectual performance depends on abilities, methods, knowledge, and attitudes. These are organized into six categories of training:
Foundations of Reasoning - observation and classification, ordering, hierarchical classification, analogies, spatial reasoning and strategies.

Understanding Language - word relations, language structure, reading comprehension.
Verbal Reasoning - assertions, arguments.
Problem Solving - linear representations, tabular representations, representations by simulation and enactment, systematic trial and error, thinking out implications.
Decision Making - the nature of decisions, using information, analyzing complex situations.
Inventive Thinking - analyzing and improving designs, procedures as designs.

Targeted population: grades 4 to 6.

Expected outcome(s): To teach students to perform intellectual tasks that require prudent observation, deductive reasoning, careful use of language, inferential use of information, hypothesis generation and testing, problem solving, inventiveness and creativity, decision making, and related skills.

Promotion of independent generalized learning: After a teacher demonstration, students are encouraged to use the materials independently. In some lessons there are activities called "challenges," where students are asked to apply a strategy on a process in an out-of-school context.

Example: In a lesson called Understanding the Author's Message, students can better understand written material if infer deduce the author's purpose in writing it. The lesson is therefore designed to give students instruction and practice in inferring an author's intentions in different kinds of text.

Efficacy evidence: The results of a study done in Venezuela show increased student achievement on tests of thinking and on standardized tests. For example, in the related Project Intelligence program a group receiving the instruction scored better on task measures such as number of solution features and amount of detail (Perkins, 1984).

Conceptual Infusion (Swartz, 1987)

Assumptions: Good thinking can be attributed to the components of skills, activities, and dispositions. These component processes are useful in various natural thinking contexts. Usually, a mix of these components go together in strategic ways to yield good thinking.

Goals:
1. To emphasize specific skills, activities, and dispositions as educational goals.
2. To teach these goals in natural thinking contexts.
3. To teach strategies for using these skills, activities, and dispositions in these contexts.
4. To find natural thinking contexts in the present curriculum.

Methods and materials: Science textbooks that include thought-provoking situations followed by a series of prompts in the form of specific questions raised in sequence according to the instructional model.

Thinking skills: Conceptualizing alternative possibilities, looking for good evidence, the need to rule out competing hypotheses, and collecting and assessing evidence.

Targeted population: elementary and high school.

Expected outcome(s): The desired result is ". . . reasonable reflective thinking directed at deciding what to believe or do" (Ennis, 1987, p 10). Examples include engaging in well-founded forms of intelligence, judging the reliability and accuracy of the information on which such inferences are based, and exercising clarity and precision in the way the thoughts are conceptualized.

Promotion of independent generalized learning: Students are encouraged to think of and describe some examples in their own life in which they would like to find out why something happened.

Example: Students are asked to list all possible explanations for a high blood pressure reading. Then, students are asked to suggest a way that each of these explanations could be tested.

Efficacy evidence: None given in sources reviewed.

Jasper Series Cognition and Technology Group at Vanderbilt (1992).

Assumptions: Based on the constructivist position of learning, students should be active in the construction of knowledge rather then mere receivers of transmitted material, and students need repeated opportunities to engage in in-depth exploration, assessment, and revision of their ideas over extended periods of time.

Goals: Students are motivated to think and reason about important, complex problems.

Methods and materials: Anchored instruction programs are used. Anchored instruction is instruction in the context of meaningful problem solving environments. These "macrocontexts" allow students to formulate and solve a set of interconnected subproblems. Videotaped adventures of a central character are used (15-20 minutes) along with other multimedia software.

Thinking skills: Students are afforded opportunities to solve interconnected problems. Students who are relative novices in an area are allowed to experience some of the advantages of experts when they are trying to learn new information about their area. The approach is designed to first have the novice use the available knowledge to attempt to understand the phenomena and activities depicted in an anchor and to then be able to experience the changes in their own attention and understanding as they are introduced to concepts and theories that are relevant to the anchors.

Targeted population: late elementary age to early high school.

Expected outcome(s): Students who are more generative learners and more self-directed rather than teacher directed.

Promotion of independent generalized learning: Students work cooperatively, but with little intervention from the teacher. One major goal is to foster self-directed learning.

Example: In one adventure, the central character and his friends are faced with the challenge of rescuing a wounded eagle from a dense forest. The student is given information which creates quite a complex problem where many factors must be considered.

Efficacy evidence: Students showed improvement from the beginning to the end of the year in word problems and planning skills (Cognition and Technology, 1992). Jasper students increased scores on the planning challenge by about 20 points, while the control students raised their scores by 6 points. On the subgoal of comprehension, Jasper students increased by 24 points, while the control students gained 11 points. They also showed significant improvements in their attitudes towards problem solving.

Relation of Skills Among Existing Programs

The content of the instructional programs was reviewed to determine whether they included specific skills that would be consistent with the evolving requirements of the Practical Thinking curriculum. These specific skills were determined independently from this review and were compared to the skills and attitudes contained in the reviewed programs. (See Fallesen, Michel, Lussier & Pounds, in preparation, for the requirements.) The requirements were identified based on observation of weaknesses in tactical decision making processes. Among other limitations, tactical decision making suffers from mind-sets, using one standard procedure regardless of situational differences, being unaware of critical assumptions, using weak or rationalized support for assertions, and lack of experience (Fallesen, 1993). The extent to which the skills implied in these deficiencies are included in the reviewed programs suggests a convergence of the important skills. Also skills that are hypothesized to exist and are not included in any of these reviewed programs indicate where new ground can be broken.

There were five topics or themes from the Practical Thinking lessons against which the cognitive instruction programs were reviewed. The first topic was on multiple perspectives, the ability or tendency to switch how one looks at a problem. Taking a different perspective is useful to generate different understandings of the problem, create solutions, and assess solutions. Different perspective includes being able to force a different perspective when the problem solver is "stuck" or to consider various perspectives to survey many possible problem and solution states. The second topic, adapting to situations, is the tendency to match one's capabilities to how they respond to a situation or a problem. Adapting to situations relies on thinking about thinking (metacognition) to achieve focus and efficiency. The third lesson topic is about finding hidden assumptions. Hidden assumptions are those aspects of a situation that are not apparent as assumptions. Hidden assumptions unnecessarily narrow one's outlook, and can lead to inappropriate solutions. Practical reasoning is the fourth lesson topic and covers informal reasoning that people use in everyday problem solving. The objective of the lesson is to convey standards of reasoning (specifically, fairness, relevance, evidence, clarity, and consistency) and to give examples of poor reasoning to avoid. The fifth topic on integrative thinking illustrates different levels of thinking complexity and implies the characteristics of putting the "big picture" together.

Table 4 presents how the cognitive instruction programs correspond to the five Practical Thinking themes. All the programs except Instrumental Enrichment were related to three or more of the themes.

Table 4.
Relevant cognitive skills from reviewed programs for Practical Thinking.

Program	Multiple perspectives	Adapting to situations	Finding hidden assumptions	Practical reasoning	Integrative thinking
Structure of Intellect 1967	divergent production	evaluation		convergent reasoning	
Cognitive Research Trust Thinking 1973	broaden thinking, escape from imprisoning ideas, PMI, C&S, EBS, OPV, TEC	organize thinking, AGO (aims, goals, objectives)	PMI, EBS, OPV, CAF	assess evidence	
Productive Thinking Program 1974	use more original ideas, generate ideas, creating new perspectives, evaluate & improve ideas	persist at problem solving		discovering and formulating problems	organizing and using information
Patterns of problem solving 1975	overcome conceptual block and self-imposed constraints, restate question, consider many alternative COAs		challenge premises	use partial solutions	
Philosophy for Children 1976	discovery, invention, possibilities, explore alternatives to own point of view		contradiction, explanations & descriptions, consider consequences, search for presuppositions, reasons for beliefs	inductive reasoning, consider evidence objectively	cause & effect
Heuristic instruction in mathematical problem solving 1979		identify givens/ unknowns, develop a plan for proceeding, explore what to do for unclear paths, use managerial strategies	analysis to identify givens/unknowns		

Table 4. (continued)

Program	Multiple perspectives	Adapting to situations	Finding hidden assumptions	Practical reasoning	Integrative thinking
Practicum in Thinking 1979	approach problems in more than one way	self-awareness, learn something about selves, recognize choices in how problem approached			
Instrumental enrichment 1980		reflectivity			
Heuristic Model 1984	consider controlling factors, constraints	consider constraints, remain open to solutions and flexible		consider validity, relevancy and consistency; assess and revise predictions	make predictions, understand relationships
IDEAL 1984	overcome functional fixedness, consider component attributes	make parts of complex problems routine, apply prior knowledge to situation	challenge basic assumptions, make assumptions explicit, search for inconsistencies	challenge accuracy, logic of conclusions	promote active understanding
Critical Thinking in American History 1985		self-reflective	willingness to suspend judgment, view knowledge as open to interpretation, recognize assumptions, unstated assumptions	provide good reasons for beliefs, evaluate evidence, go beyond simple solutions, identify imprecise words	identify connections in an argument
Intelligence applied 1986	understand how different reasonable definitions lead to different strategies	identify potential problems during planning stages, select strategies			conflict resolution
Conceptual infusion 1987	conceptualize alternative possibilities	reflective thinking		look for good evidence, rule out competing hypotheses, assess evidence, judge information reliability, exercise clarity	
Odyssey 1986	inventiveness, analogy, different points of view when reading	gather and evaluate information to reduce uncertainty	read for meaning, evaluate assertions	evaluate plausible arguments	inferential use of information, hypothesis generation & testing
Jasper Series 1992	consider multiple factors			assess, revise own ides	solve interconnected problems

Twelve of the fifteen programs had skills related to multiple perspectives and adapting to situations. The previous cognitive instruction programs covered understanding and overcoming barriers to ideas. Some programs advocated taking new perspectives, different perspectives, many perspectives, and broad ones. Also the programs addressed considering other strategies for how problems are solved or decisions made. The reviewed programs also addressed adapting to the situation by promoting reflection and understanding of how individuals themselves think. The programs covering adaptation also covered skills of organizing and persistence for dealing with problems.

Finding hidden assumptions was covered in seven programs by showing ways to identify or recognize contradictions, inconsistencies, and unstated or implicit assumptions. Part of finding hidden assumptions involves challenging accepted beliefs and knowledge.

Eleven of the programs related to practical reasoning. They covered checking the assessment of evidence, clarity, reliability, accuracy, validity, consistency, and plausibility. In some cases they addressed the logic of conclusions, screening of hypotheses, and going beyond simple solutions. Eight of the programs related to elements of integrative thinking. These dealt with resolving conflicts, generating hypotheses, making inferences and predictions, identifying connections or relationships among information.

Although there were relations in topics, it is suspected that there are subtle differences in the intention and content of the existing cognitive programs and those of the Practical Thinking curriculum. For example, while some of the previous programs covered reasoning, they tended to do so from a logical standpoint. The Practical Thinking requirements noted the limitations of a logical approach, and chose to extend the lessons to everyday and informal logic. Similar differences are suspected on other topics, partly due to the age of some of the programs and the advances that have been made in cognitive theories. Also the differences could be partly due to the younger audiences to which most of the programs were targeted.

Summary of Cognitive Instruction Programs

These programs do not have an overwhelming research and evaluation base to support their use (Idol & Jones, 1991), but results are all in the positive direction. There was no empirical evidence reported for four of the programs (Heuristic Model, IDEAL, Patterns of Problem Solving, and Conceptual Infusion), but they appeared to be carefully developed and had promising features. Other programs had subjective reports of positive results. Intelligence Applied indicated qualitative improvements. Critical Thinking in American History (CTAH) showed improvement in attitudes about knowledge. The Cognitive Research Trust Thinking (CORT) led to improved attention to ideas and anecdotal reports for better perceptual thinking.

Some of the programs showed improved component measures, but no noticeable effect on overall problem solving. The Productive Thinking Program had improvement indicated by greater fluency, better ideas, recognition of anomalies, but not more or better solutions. Heuristic instruction showed improvements in mathematical problem solving. Odyssey resulted in gains in the number of solution features considered and the amount of detail. Philosophy for Children resulted in improved reading skills. Practicum in Thinking showed improvements in working with others and generating new ideas.

Some programs did find positive results on attitudes and overall performance. Structure

of Intellect had positive results on attitudes and performance and improved arithmetic performance on the SAT. The Jasper Series had positive results as indicated by better scores on word problems and planning tasks. The Instrumental Enrichment program offers a considerable amount of support for performance and attitude improvement.

The trend in data is generally positive but difficult to fit into a single coherent picture. Nickerson (1984) points out that

> "educational evaluation is inherently difficult, and its results are seldom unequivocal; program developers have sometimes been sufficiently convinced of the merits of their approach that they have not been motivated to attempt an evaluation themselves. . . . Quantitative data on a few programs indicate that they produce modest improvements in performance on a variety of tests of mental ability. They make it clear that no one can yet assure the development of effective thinking skills in the classroom, but they reinforce the conviction that the goal is a reasonable one and that progress is being made in its pursuit." (p 36)

The determination of generalizability to specific career field or jobs is even less clear, because of the lack of application, difficulty of measurement and failure to track for any amount of time. Four of the programs did not provide information on the generalizability or transfer of the skills. Several of the programs made it an explicit point to encourage transfer, but did not mention how that was done (Cognitive Research Trust Thinking, IDEAL, Intelligence Applied, and Odyssey).

Most interesting are the techniques used by those programs which required actual practice of the transfer of the skills. In the Philosophy for Children program, practice exercises emphasized the application of the thinking skills to published material encountered in everyday materials, such as advertisements and letters to the editor. Instrumental Enrichment provides *bridging activities* for transfer. Critical Thinking in American History encouraged classroom debates and individually prepared essays to form and present the student's own views. The Conceptual Infusion approach has the students think of examples when they could use the skills, e.g. to find out why something happened. Practice is encouraged in the Jasper Series by having the students work on similar problems and extensions of the problems. The additional sessions focus on developing flexible knowledge structures and to make connections between the tasks in the video scenarios and historical events. Having the students apply the skills to everyday or personal situations seems like a good technique to reinforce the skills.

The differences in context must be considered to use the previous cognitive programs for a new course for Army leaders on Practical Thinking. One clear difference is the target population. Five of the programs target at least up to college students, while only three programs (Structure of Intellect, Instrumental Enrichment, and IDEAL) include adults in their target audiences. Most of the programs have been focused on a generally younger population, and none of those reviewed relate to specific jobs. This increases the importance of identifying appropriate skills, materials, and results with an entirely different target population.

The time available for classroom instruction of Army leaders is under more severe demands than the general curricula of most of these applications. Most of the reviewed programs require fairly extensive class room time over an extended period. The Instrumental Enrichment program cites a minimum of 80 hours over a 1 to 3 year period, and it takes about

100 hours before improvements are noticed. The college programs (Patterns of Problem Solving, Practicum in Thinking, and Intelligence Applied) run from about 40 to 100 hours of class time. Considering that typical schooling falls into 15 to 30 hours of classroom contact per week with many topics to cover, the cognitive instruction programs make considerable demands on schedules in civilian applications. These rather lengthy periods of instruction point to the need to develop a very efficient curriculum.

In general, there is a tremendous amount of variety among the programs with regard to the thinking skills advocated by each. They tend to cover a considerably large number of general thinking skills. The variety of general skills and specific skills that are targeted by these programs lend credibility to the selection of skills and teaching points upon which the Practical Thinking instruction for Army leaders was based.

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